Food of *Rana tigerina* (Daud.)[1]

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The Indian Bull-Frog, *Rana tigerina* (Daud.) is a widely distributed, important frog of India. A common species in fields under wet cultivation, its insectivorous habit helps in no small way, in eradicating agricultural and other pests. However, as the frog is edible, its heavy commercial exploitation has resulted in considerable depletion of its number and as such its present status is a cause for concern. This study is an effort directed not only towards collecting data on the natural diet of the frog but also towards determining the role it plays in the economy of nature.

Earlier literature on the food of *R. tigerina* includes papers, among many others, by Gostling (1895), Chibber (1911), Agharkar (1912), Mullan (1912), Davidson (1916) and Zutshi (1926) but most of these refer to observations on unusual rather than the normal food of the species. Wadekar (1963) listed the different food items of the frog while attempting to correlate the diet with their availability during different months of the year. Joshee (1968) examined the stomach contents of 100 frogs that were brought to the laboratory for dissection.

Materials and Methods

The stomach contents of 347 frogs, collected between September 1970 to August 1971 were examined. The majority were captured during the early morning hours, from paddy fields near Bombay. The specimens were brought to the laboratory, their snout to vent length and weight were recorded and the stomachs removed and preserved in 10 per cent formalin for subsequent detailed examination of their contents. Different food items from individual stomachs were identified as far as possible and their numbers, weight and economic importance, if any, noted. The available data was then tabulated monthwise and also in relation to the size of the specimens with 20 mm gradation. Frogs

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below the size of 50 mm were not considered because the food in their stomachs, besides being scanty, was difficult to analyse.

Food of *Rana tigerina*

Table 1, gives monthwise analysis of the different food items consumed by *R. tigerina*. It indicates that insects and crabs form its main diet almost throughout the year in the Bombay area. A brief account of the various food items recorded during the study is given below.

Annelids and Molluscs:

Though a few earthworms and gastropods were recovered from the stomachs of a few small sized individuals, there is no reason to believe that they form regular items of the diet.

Arthropod:

Anthropods as represented by insects and crabs from the bulk of the diet of *R. tigerina*. An insignificant number of centipedes and arachnids were also recorded from the stomachs of a few specimens.

Amongst the arthropods, insects appear to be most favoured diet of this animal. As many as forty-one species of insects belonging to ten different orders were recovered from their stomachs. There is, however, no indication to show their particular preference for any of these species. Since a number of orthopteran and coleopteran species are available during major part of the year, the representatives of these two orders naturally form the bulk of their insect diet. A number of these insects are of significant economic importance. Table 2 gives the status of the various insects fed on by the frog. Thirteen among these are important agricultural pests, four house-hold pests and four others are injurious to trees. As an indiscriminate feeder, the frog feeds on some harmless or even some of the directly or indirectly useful insects, but this does not in any way affect the important role it plays in the biological control of insect pests.

Crabs are next in importance to insects in the diet of *R. tigerina*. These crustaceans which are often seen in the paddy-fields cause considerable damage to the bunds in the fields by boring holes in them. In addition, they also damage the paddy crop during the flowering season of the paddy (McCann 1932, Jabir Ali 1955). The frog thus keeps in check the population of yet another group of animals harmful to agriculture. The occurrence of *Varuna litterata*—an estuarine crab in the stomachs of a few individuals was thought to be rather unusual. However, observations on the feeding habits of this crab revealed that it often invades the adjoining paddy fields for its food and is taken by the frog during such visits. The largest of the crabs consumed weighed 27 gm.

Vertebrates:

Representatives of all the vertebrate groups were recovered from the stomachs of a number of frogs, but they do not appear to form a part of the regular diet of the frog. However, it may be mentioned that cannibalism is quite common in *R. tigerina*. On one occasion a frog measuring 175 mm in length was seen devouring another frog of the same species measuring 110 mm. It seems that individuals of other species of anurans are also taken.

Miscellaneous:

In addition to these varied food items extraneous material like vegetable matter and gravel was often seen in the stomachs of a number of individuals. Most of the vegetable matter was, however, also seen in an undigested condition in the rectum, suggesting thereby that this material is not digested by them and as such cannot be considered as forming part of their food. The frequent occurrence of gravel in the stomachs of frogs is reported by a number of workers. During the course of the present investigation an individual was seen with as many as seven small pieces of stones weighing totally about 19 gm. It is not known whether gravel is swallowed intentionally. It seems more likely that the gravel as also the vegetable matter is taken up by the animal, accidentally, along with food.

Table 3 gives the various food items consumed by different 20 mm size groups of *R. tigerina*. It is evident that whereas insects and crabs form the main diet of all the different size groups, annelids and molluscs are consumed by small sized and vertebrates by the bigger frogs. It can, therefore, be surmised that insects and crabs constitute the main food of this frog.

The available facts thus indicate that *R. tigerina* plays a very significant role in controlling agricultural and other pests in the field and thus plays a very important role in the economy of nature.

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TABLE 1

MONTHWISE ANALYSIS OF THE STOMACH CONTENTS OF *R. tigerina* (DAUD.)

Number of the individual food items collected/number of stomachs from which collected.

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
ANNELIDA													
(Earthworms)													
Pheritima sp.	2/2	—	—	—	—	—	—	—	—	2/1	3/1	—	
MOLLUSCA													
Ariophanta sp.	1/1	—	—	1/1	1/1	—	—	—	2/2	—	—	—	Shells found in undigested condition.
Planorbis sp.	—	—	—	1/1	—	—	—	—	2/2	—	—	—	
Pila virens	—	—	—	—	—	—	—	—	2/1	—	1/1	—	
ARTHROPODA													
Class *Insecta*													
Order ODONATA (sp. not identified)	—	—	—	4/2	2/1	—	—	—	—	2/2	—	—	
Order ORTHOPTERA													
Family Gryllidae													
Gryllotalpa africana	4/2	2/2	—	—	—	—	—	—	—	1/1	2/1	—	Pest on paddy.
Gryllotalpa sp.	5/2	23/4	6/4	2/1	6/2	—	3/1	—	1/1	10/4	4/2	3/2	Pest on paddy.
Schizodactylus monstruosus	—	—	—	1/1	—	2/1	—	2/2	—	1/1	—	—	
Brachytrypes sp.	5/2	2/1	4/1	—	—	—	2/1	—	2/1	3/3	2/1	—	Injurious to seedlings.

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Family Tettigoniidae													Economically not important.
Holochlora albida	3/2	2/2	2/2	1/1	—	—	—	1/1	—	3/2	2/2	1/1	— do —
Callimenelus opacus	1/1	—	—	—	1/1	2/1	—	—	—	—	2/1	—	Appear in Oct.-Nov., feed on leaves of trees.
Mecopoda elongata	—	—	3/2	6/4	1/1	—	—	—	—	—	—	1/1	
Family Acridiidae													Very harmful to rice.
Hieroglyphus banian	5/2	7/3	1/1	1/1	—	—	—	—	2/1	3/2	9/2	1/1	Harmful for low growing plants.
Parella sp.	2/2	3/1	—	1/1	2/1	—	—	1/1	2/1	4/4	—	6/2	
Scelimena sp.	3/2	7/5	3/2	4/2	2/2	6/1	—	—	4/1	2/1	—	2/2	Harmful to crops in marshy places.
Order DERMAPTERA Family Labiduridae *Labidura riparia* (Earwigs)	1/2	2/2	2/2	2/2	1/1	4/4	2/2	2/1	2/1	3/2	3/3	2/1	Carnivorous, eats small insects.
Order BLATTIDAE Cockroach	2/1	—	1/1	2/1	—	—	—	—	3/2	3/1	—	—	Household pest.
Order ISOPTERA Termites	—	15/4	—	—	—	—	—	—	—	**/5	15/1	7/2	Household pest. (** several)

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Order RHYNCHOTA													
Family Corixidae													
Corixa sp.	8/2	6/1	—	—	—	—	—	—	—	4/1	—	4/2	Bug; plant sucker.
Family Belostomatidae													
Belostoma indica	3/3	1/1	2/2	—	—	1/1	—	—	—	2/2	2/2	2/1	Carnivorous water bug.
Sphaerodema sp.	3/2	—	1/1	3/2	—	—	—	—	—	3/3	2/1	—	Carnivorous water bug.
Family Nepidae													
Laccotrephes ruber	3/2	2/1	1/1	—	—	2/1	—	—	2/2	3/2	2/1	3/2	Lives in water and is predacious on other water insects and other animals.
Order LEPIDOPTERA													
Heterocera	—	3/2	9/5	2/2	—	—	—	7/3	—	2/1	7/2	2/1	Larvae and adult.
Order DIPTERA													
Family Syrphidae													
Eristalis sp.	—	—	3/1	—	12/9	22/10	—	10/4	—	1/1	—	2/1	
Family Muscidae													
Musca sp. (House Fly)	—	—	1/1	—	—	—	—	—	—	15/1	—	2/1	Household pest.

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Order HYMENOPTERA													
Family Eumenidae (Wasp)													
Rhynchium sp.	—	2/2	—	—	—	3/2	—	—	1/1	—	—	—	
Family Formicidae (Ants)													
Camponotus compressus	6/5	—	4/3	4/2	—	2/1	—	—	1/1	—	7/4	4/4	
Solenopsis geminata	16/2	—	3/1	—	—	3/1	—	—	5/1	8/2	3/1	1/1	
Aphaenogaster beccarii	—	—	15/1	—	3/2	—	5/2	20/2	—	—	2/1	—	
Oecophylla smaragdina	—	—	—	—	—	4/1	—	—	—	11/1	6/2	—	A nuisance on trees, weaving leaves together. Collects small insects.
Family Apidae													
Apis dorsata	1/1	—	—	—	—	—	—	—	—	—	—	2/1	Economically useful.
Order COLEOPTERA													
Family Cicindelidae													
Pherosophus sp.	1/1	2/1	2/2	—	—	1/1	—	—	—	—	2/2	1/1	Tiger beetles. Carnivorous adults and larvae eat insects.
Family Carabidae													
Ophanus indicus	—	2/2	1/1	—	—	—	1/1	—	—	4/2	—	2/1	Ground beetle. Generally a scavenger. Larvae may harm roots of plants.

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Harpalus sp.	—	4/1	3/1	—	2/1	—	—	—	—	5/2	12/2	3/1	
Family Dytiscidae													
Cybister sp.	—	2/2	—	1/1	3/2	—	1/1	—	—	2/1	3/2	—	Carnivorous water beetle.
Family Hydrophilidae													
Stethoxus sp.	2/2	4/2	4/3	2/1	1/1	—	—	—	—	3/2	—	2/2	Larvae in water and carnivorous.
Family Scarabaeidae													
Catharsius molossus	1/1	2/1	—	2/1	—	—	—	1/1	—	—	2/1	2/1	Dung roller.
Anomala elata	2/2	4/2	8/3	3/2	2/1	—	12/4	—	2/1	13/9	—	16/6	Larvae destroys roots of trees, adults feed on plant leaves. Harmful to agriculture.
Anomala bengalensis	3/2	1/1	2/2	—	1/1	3/2	5/4	1/1	2/2	—	2/2	4/2	Harmful to roots in larval stages. Feeds on leaves as adult.
Onitis sp.	1/1	2/1	—	—	—	—	—	—	1/1	—	1/1	—	Beetles not particularly harmful, scavengers.
Family Elateridae Unidentified	2/1	4/2	1/1	—	2/1	—	—	4/1	—	2/1	3/2	4/1	Generally predators.

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Family Tenebrionidae *Pseudoblaps* sp.	1/1	2/2	—	4/2	—	—	—	2/1	—	2/2	—	2/1	Beetles not of economic importance.
Family Cerambycidae *Priotyrannus mordax*	3/1	1/1	2/2	—	—	—	—	3/2	2/1	—	4/1	2/1	Lives in forest areas feeding on dead material.
Batocera sp.	2/1	3/2	4/2	6/2	5/2	—	—	2/1	8/3	4/1	2/1	6/2	Harmful borer.
Family Chrysomelidae Unidentified	2/1	12/2	—	13/2	—	4/1	—	—	1/1	7/5	16/1	8/4	Harmful to leaves of plants. Found in large numbers.
Class ARACHNIDAE Spiders (*Aranae*)	1/1	2/1	—	—	3/2	—	—	1/1	4/2	*66/1	—	—	* All specimens (except one) were young spiders.
Centipedes	—	1/1	—	—	—	—	—	—	—	—	1/1	—	
Scorpions	—	—	1/1	—	—	—	1/1	—	—	—	1/1	—	
Class CRUSTACEA *Paratelphusa guerini*	6/6	7/5	5/4	3/3	4/2	4/4	3/2	—	—	6/3	7/5	9/7	Common in paddy fields and pest of crops.

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Paratelphusa jacquemontii	4/3	3/2	2/2	3/1	2/2	—	—	1/1	—	3/3	2/1	3/2	Noticed more in the monsoon season when it comes out of the burrows. This is also their breeding season.
Gecarcinucus jacquemontii	2/1	1/1	—	1/1	2/2	—	—	1/1	1/1	2/1	1/1	2/2	This damages bunds by burrowing.
Varuna litterata	2/2	3/2	1/1	—	2/2	—	—	3/3	—	2/1	1/1	—	An esturine crab.
VERTEBRATE													
Class PISCES													
Heteropneustes fossilis	1/1	—	1/1	—	—	—	—	—	—	—	1/1	—	84-85 mm in length.
Rasbora daniconius	—	1/1	—	—	—	—	—	—	—	1/1	—	1/1	50 mm in length.
Gobius giuris	—	—	—	—	—	—	—	—	—	—	1/1	1/1	70 mm in length.
Puntius sp.	1/1	1/1	—	—	—	—	—	—	—	—	1/1	—	145 to 161 mm in length.
Class AMPHIBIA													
Family Bufonidae													
Bufo melanostictus	—	—	—	—	—	—	—	—	—	—	6/1	—	Tadpoles.
Family Ranidae													
Rana tigerina	1/1	—	—	1/1	—	—	1/1	—	—	2/1	—	—	
Rana limnocharis	—	1/1	—	—	—	—	—	—	—	1/1	2/1	—	

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Class REPTILIA													
Family Scincidae													
Mabuya carinata	—	1/1	—	—	—	—	—	—	—	—	—	—	
Order OPHIDIA													
Family Colubridae													
Xenochrophis piscator	1/1	—	—	—	—	—	—	—	—	—	1/1	—	Non-poisonous.
Amphiesma stolata	—	—	—	—	—	—	—	2/2	—	—	—	—	Half digested (non-poisonous).
Lycodon aulicus	—	—	—	—	—	1/1	—	—	—	—	—	—	A part only.
Class MAMMALIA													
Rattus rattus	1/1	1/1	—	—	—	—	—	1/1	1/1	1/1	—	1/1	Pest of crops.
Suncus murinus	1/1	—	—	—	1/1	—	—	1/1	—	—	1/1	—	
Vegetable matter	ve/4	ve/8	—	—	ve/2	—	—	ve/3	—	—	ve/4	—	ve = Vegetable.
Gravel	gr/10	gr/5	gr/15	gr/12	gr/9	gr/20	gr/12	gr/14	gr/10	gr/14	gr/11	gr/8	gr = Gravel.

TABLE 2

INSECTS CONSUMED BY *R. tigerina* (DAUD.) GROUPED ACCORDING TO THEIR ECONOMIC IMPORTANCE

Species	Number of insects	Number of Frogs examined
Insect pests of crops		
1. *Gryllotalpa africana*	9	6
2. *Gryllotalpa* sp.	63	23
3. *Brachytrypes* sp.	19	10
4. *Hieroglyphus banian*	29	13
5. *Parella* sp.	21	13
6. *Scelimena* sp.	33	18
7. *Corixa* sp.	22	6
8. *Eristalis* sp.	50	26
9. *Ophanus indicus*	10	7
10. *Anomala elata*	62	30
11. *Anomala bengalensis*	24	19
12. *Batocera* sp.	38	17
13. Chrysomelid	66	17
Total	446	205
Insects injurious to trees		
1. *Mecopoda elongata*	11	8
2. *Solenopsis geminata*	39	9
3. *Oecophylla smaragdina*	21	4
4. *Onitis* sp.	5	4
Total	76	25
Household pests		
1. Cockroach	11	6
2. Termites	37	12
3. *Musca* sp.	18	3
4. *Priotyrannus mordax*	17	9
Total	83	30

TABLE 2 (continued)

Species	Number of specimens	Number of Frogs examined
Carnivorous		
1. *Holochlora albida*	15	13
2. *Callimenelus opacus*	6	4
3. *Labidura riparia*	26	23
4. *Belostoma indica*	13	12
5. *Sphaerodema* sp.	12	9
6. *Laccotrephes ruber*	18	12
7. *Rhynchium* sp.	6	5
8. *Pherosophus* sp.	9	8
9. *Cybister* sp.	12	9
10. *Stethoxus* sp.	18	13
11. *Catharsius molossus*	10	6
12. Elaterid	22	10
Total	167	124
Indeterminate		
1. *Camponotus compressus*	28	20
2. Odonata	8	4
3. *Pseudoblaps* sp.	13	9
Total	49	33
1. *Harpalus* sp.	29	8
2. *Schizodactylus monstruosus*	6	5
3. Heterocera	45	7
4. *Aphaenogaster beccarii*	45	7
Total	125	27
Useful insect		
1. *Apis dorsata*	3	3

TABLE 3

FOOD ITEMS BY THEIR NUMBER AND WEIGHT AS CONSUMED BY DIFFERENT 20 MM SIZE GROUPS OF *Rana tigrina* (DAUD.)

Size	Annelida No./wt. gm.	Molluscs No./wt. gm.	Insects No./wt. gm.	Crabs No./wt. gm.	Arachnids No./wt. gm.	Pisces No./wt. gm.	Amphibians No./wt. gm.	Reptiles No./wt. gm.	Birds No./wt. gm.	Mammals No./wt. gm.
50-69	3/0.7	4/1.5	97/13.5	4/14.5	*66/3.5	—	—	—	—	—
70-89	2/0.5	2/0.7	103/12.2	7/25.0	1/5.2	—	**6/2.2	—	—	—
90-109	2/0.5	3/0.4	109/16.9	9/31.2	2/4.5	1/7.5	1/45.5	1/13.5	—	1/11.5
110-129	—	2/0.7	146/18.2	12/43.4	2/6.4	2/16.2	3/35.3	1/43.8	—	2/26.4
130-149	—	—	177/26.8	15/51.7	3/5.3	2/12.5	3/32.4	1/53.9	—	2/42.8
150-169	—	—	147/16.4	20/69.2	4/3.2	3/16.5	2/27.2	1/51.2	1/13.5	2/31.2
170-	—	—	143/15.3	37/127.5	3/6.5	3/14.2	2/64.3	2/69.3	—	3/57.5

* Small spiders ** Tadpoles

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